

BARRIERS TO DEVELOPMENT OF TECHNOLOGY ENTREPRENEURSHIP IN SMALL AND MEDIUM ENTERPRISES

Marek Matejun*

*Department of Management, Lodz University of Technology, Lodz, 90-924, Poland
Email: matejun@p.lodz.pl

Abstract Technology entrepreneurship focuses on transforming research and scientific potential into innovative goods and services. It is an interesting proposition for small and medium-sized enterprises planning to improve the competitive position based on advanced technology. Its use in economic practice faces certain limitations, arising both from the specifics of that category of entities and the external conditions of their operation. This article aims to identify and analyze of the incidence of barriers to technology entrepreneurship and to assess the impact of these negative factors on the development and benefits of using this concept in the SME sector companies. The survey conducted on a sample of 300 small and medium-sized enterprises from the region of Lodz aims at achieving the objective of the paper. The results allowed to determine the impact of selected barriers (considered by generic criterion and the direction of impact) on the level of development of technology entrepreneurship.

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1. INTRODUCTION

Technology entrepreneurship involves the introduction of new technologies and innovative products and services in response to market opportunities and chances, based on a powerful combination of business resources and the potential of their external environment represented by the sphere of science, research and development and business institutions.

This concept seems to be particularly interesting for small and medium-sized enterprises, which are usually characterized by resource shortages hindering the independent management of innovative activity. The development of technology entrepreneurship in the business practice of companies in the SME sector, however, faces a variety of barriers. Theoretical description and empirical identification of these factors is an important cognitive area which allows to increase the involvement of these entities in the development of technology entrepreneurship.

Taking this into account as the objective of this article the identification and analysis was determined of the scope of technology entrepreneurship barriers and assessment of the impact of these negative factors on the development and benefits of using this concept in economic practice of small and medium-sized enterprises. The empirical research using a survey conducted on a sample of 300 small and medium-sized enterprises from the region of Lodz aims at achieving the objective of the paper.

2. THE CONCEPT AND FACTORS OF DEVELOPMENT OF TECHNOLOGY ENTREPRENEURSHIP IN THE SME SECTOR COMPANIES

Entrepreneurship understood as a creative activity involving the creation of new value through active efforts, sacrifice of own time and resources, taking into account the specific risk, aimed at ensuring the independence of action, personal satisfaction and wealth (Hisrich, 2014, pp. 8-9) is most practically reflected in the functioning of small and medium-sized enterprises (Piecuch, 2010, pp. 28-29). One type of this activity is a technology entrepreneurship, which includes activities focusing on the use of opportunities present in the environment to implement innovative technical solutions and related products and services. Its essence is the transformation of research and the potential of scientific and research and development institutions into goods and services distributed on a commercial basis and providing customers with new values and the desired benefits (Flaszewska, Lachiewicz, 2013, pp.15-18). It is closely linked to the merits of such concepts as academic entrepreneurship (Poznańska, 2014, pp. 164-172) or intellectual entrepreneurship (Kwiatkowski 2000) and focused on the transfer of new knowledge to private com-

panies, which increases productivity and strengthens and perpetuates their competitiveness, and consequently, leads to the formation of new businesses, increases investment and employment, mainly in the fields of high technologies (Banerski, Gryzik, Matusiak, Mażewska & Stawasz, 2009, p.34).

The formula of technology entrepreneurship is particularly beneficial for small and medium-sized enterprises that have already achieved a certain level of growth and based on modern technologies are planning further market expansion stages. Too little self-potential prevents them from operating independently of innovative activity leading to increased involvement in transfer of knowledge and new technologies from scientific and technical environment (Flaszewska & Lachiewicz, 2013, pp. 21-22) while leveraging the potential and support of environment for small business (Brown & Mason, 2014, pp.773-784). The nature and scope of the concept of technology entrepreneurship indicates that the application of this concept in practice of functioning of the SME sector companies needs to provide activity in four main areas:

1. Internal entrepreneurship of a company associated closely with the concept of intrapreneurship aimed at making brave efforts to commercialize ideas and opportunities identified by members of the organization in order to create economic value (Parker, 2011, pp.19-20). It plays an important role in the SME sector companies and is based on developing appropriate organizational conditions for the development of entrepreneurship and on stimulating entrepreneurial behavior of employees (Van der Sijde, Veenker & Daring, 2013, pp. 26-27) (Gorzelany-Dziadkowiec, 2014, pp. 90-92). In this area, activities aimed primarily at creating an attitude of openness to knowledge and new solutions among employees, listening to and implementing crew's ideas and mitigating barriers to reported changes and creative ideas become significant.
2. Own potential for technology and innovation, the development of which should be correlative with scientific and technological progress (Bailetti, 2012, p. 9). Actions undertaken within this area include mainly the identification of needs in terms of knowledge, skills and technology, building own developmental base and the introduction of appropriate procedures and methods of diffusion, storage, codification and preservation of knowledge. In the case of SMEs, a barrier can be immanent resource deficiencies that result from the characteristics of that category of entities (Dehbokry & Chew, 2015, p. 4), which requires they take actions aimed at searching for and using the positive potential of the external environment (Kurowska, Matejun & Szymańska, 2013, p. 56).
3. Integration of business and science, which is the essence of technology entrepreneurship and stems from the growing importance of inter-organizational cooperation in the innovation implementation (Błażlak & Owczarek, 2014, pp. 57-65). However, the level of this integration is still insufficient in small business practice (Janczewska, 2014, pp. 29-30). The necessary actions in this area may include the organization of teamwork in collaboration with the staff of scientific research facilities, providing employees with access to the necessary ex-

ternal knowledge and building networks to exchange knowledge between the company and the science environment.

4. Market distribution of technological and innovation effects, which is associated with the placing on the market of products and services created in the process of technology entrepreneurship. The requirement here is the development of marketing orientation and related marketing capabilities (Lin, 2015, pp. 292-293) aimed at personal contacts with customers, individualization of the offer and concentration of activities in market niches found mostly on local and regional markets (Safin, 2008 pp. 38-40). The key activities in this area include market research in terms of demand for new products and services, as well as the information necessary to implement new technologies and obtaining feedback from customers about product / service launches.

The involvement of small and medium-sized enterprises in the development of technology entrepreneurship can be a source of many benefits enabling building an efficient and sustainable competitive advantage. The most important positive effects of using this concept in economic practice include (see, more extensively: Kurowska M. & Matejun M., 2013, pp. 138-142):

- improving business efficiency, which includes, among others, increasing the internal effectiveness of decision-making, avoiding waste and unnecessary efforts, achieving higher productivity while reducing costs, mitigating risk, and preventing the emergence of crises in the enterprise,
- benefits for technology and innovation, including, among others, increasing the scope and effectiveness of innovation, shortening time to manufacture products while reducing errors and production shortages, and creating information base enabling acquisition, expansion, improvement and practical use of the available and current knowledge,
- organizational benefits, which include, among others, creating a culture based on knowledge, achieving improvements through integrated activities, as well as reducing employee turnover, developing their creativity and competence,
- market benefits, related, among others, with effects such as increased efficiency and competitiveness through flexible adaptation to emerging changes and demands of the different markets and different groups of customers, increased loyalty of customers, employees, shareholders, better adaptation to the needs of key stakeholders, as well as improved corporate image and communication system with the target market.

The development of technology entrepreneurship of small and medium-sized enterprises, however, faces a number of barriers resulting from both the characteristics of the smallest businesses and the market conditions of their functioning. The research focused on the identification and assessment of constraints to the development of the SME sector companies are included in the prospective direction of research on factors of functioning of this category of operators (Łuczka, Lachiewicz & Stawasz, 2010 p. 462). Often they concern the barriers of a general

nature (see e.g. Borowiecki & Siuta-Tokarska, 2008, pp. 178- 211), but many of them focus on the description and analysis of the limitations of small and medium-sized enterprises in the field of innovation, technological development or technology transfer (Zhu, Wittmann & Peng, 2012, pp.1131-1142) (Greve, 2014) (Marin, Marzucchi & Zoboli, 2015, pp. 671-705).

Barriers to the development of technology entrepreneurship, as well as other kinds of restrictions can be analyzed and classified from the point of view of various criteria, including, among others, the occurrence direction, the economic context, level of activity and dynamics, manner of creation, duration and specific generic categories (Matejun, 2010, p. 245). From the point of view of the specific nature and scope of the concept of technology entrepreneurship, the main barriers to its development in small and medium-sized enterprises include:

- financial barriers, including both bad situation and limited financial possibilities of the enterprises and difficult access to external sources of financing for technology initiatives and innovation,
- market barriers, which consist primarily of fierce competition and limited market for innovative solutions,
- legal and administrative barriers, including very high levels of bureaucracy processes related to conducting innovation business and technology transfer, as well as lack of knowledge and procedural difficulties related to the protection of intellectual property,
- relational barriers relating to difficulties in establishing cooperation with scientific and research centers, financial institutions and small business support centers, as well as weak negotiating position and strength of the company,
- management barriers, related, among others to a lack of planning in terms of company's market activity, lack of experience and the use of external management models, as well as the limitation of control activities and the use of strategic reflection,
- competence barriers, including inappropriate qualifications of owners, managers and employees, as well as the lack of core competencies in the field of innovation.

In addition to the generic division, also separation of internal and external barriers is of essential cognitive significance. This classification is of particular importance from the point of view of taking action to support innovation in small and medium-sized enterprises.

3. METHODOLOGY AND SCOPE OF CONDUCTED RESEARCH

The implementation of the objective of the paper comprised empirical studies conducted on a sample of 300 small and medium-sized companies of the Lodz

region. The research used survey method, being part of a nomothetic approach in the context of management sciences (Niemczyk, 2011, pp. 24-25), focused on the search for general regularities occurring in business practice based on observations of a particular sample of companies.

The research technique applied was survey technique in printed form, handed out directly to the respondents. The research tool was a proprietary questionnaire containing 40 questions, divided into four thematic blocks. The research used random sampling. The population list was a list of operators provided by an external company with which the research team worked in the course of empirical work. The study was conducted in the second half of 2012 (See, more extensively, Matejun, 2013, pp. 103-114).

The size of companies surveyed was designated on the basis of annual average level of employment under contracts of employment (in FTE), including partners engaging in a regular activity in the enterprise. The basis for determining the size was the respondents' declarations expressed in the questionnaire. Based on the assumptions of European uniform definition of SME sector, the sample identified 201 (67%) small companies - with annual average employment level in the range of 10-49 and 99 (33%) medium-sized companies (with the level of employment 50-249 employees). Wider characteristics of the surveyed entities falls in line with the qualitative particularities of small and medium-sized enterprises expressed, among others, in simplified legal forms and the limited market range (Lachiewicz & Załączny, 2003, pp. 10-13). The detailed characteristics of the analyzed entities are presented in Table 1.

Table 1 Characteristics of the SME sector companies involved in the study; Source: Own study based on the results of survey research

Company size	Quantity	%	Age of the company:	Quantity	%
Small	201	67%	up to 1 year	1	0.5%
Medium-sized	99	33%	more than 1 year to 3 years	4	1.5%
			more than 3 years to 5 years	30	10%
			more than 5 years to 10 years	90	30%
Sector of operation:	Quantity	%		Quantity	%
Services	150	50%	more than 10 years	175	58%
production	146	49%			
Trade	4	1%	Legal form:	Quantity	%
			natural person	179	59%
			civil partnership	34	11%
Area of operation	Quantity	%		Quantity	%
Local	105	35%	general partnership	5	2%
Regional	79	27%	limited liability company	66	22%
National	67	22%	joint stock company	8	3%
international	49	16%	other forms	8	3%

Respondents in the survey were owners (66%) or managers managing the analyzed companies (34%). They were primarily males (59%), people of all ages, with the majority (64%) respondents aged above 40. They were primarily people with higher education, mostly in the technical (58%) or economic (31%) fields.

The basic variables in empirical studies were adopted as follows:

- the level of technology entrepreneurship development in the surveyed entities,
- benefits from the development of technology entrepreneurship,
- barriers to the development of technology entrepreneurship in the surveyed companies.

All of them were divided into specific cognitive components (areas / groups / categories) according to theoretical considerations. The level of each component was operationalized and expressed using synthetic measures consisting of a set of substantive indicators possible to observe directly in business practice and to be assessed by the respondents. This assessment was made on the Likert scale ranging from 1 (totally not applicable to our company) to 5 (fully applies to our company). The synthetic value of individual components was determined as the arithmetic average of the indicators, while the overall level of variables was defined as the average of the cognitive components relevant to a given variable.

To assess the relationship between variables (due to their quantitative nature) Pearson correlation ratio r_{xy} (and test of significance) was used (Kot, Jakubowski & Sokolowski, 2011, pp. 301-305). To interpret the force of phenomena interdependence, an approach was adopted based on proposal by J. Cohen (1988 and 1992, pp. 155-159), adapted to the specifics of behavioral research recommended for use in the social sciences (Weinberg & Abramowitz, 2002, pp. 135-137). As threshold limit values of r_{xy} , therefore, the following levels of interdependence were adopted: 0.1 – poor; 0.3 – moderate; 0.5 – strong, 0.7 – very strong.

4. THE SCOPE AND BARRIERS TO THE DEVELOPMENT OF TECHNOLOGY ENTREPRENEURSHIP IN THE SURVEYED COMPANIES

In the present study technology entrepreneurship is defined as a set of interrelated activities carried out by small and medium-sized enterprises within the framework of 4 specific areas in accordance with theoretical considerations. The results indicate that the level of development of technology entrepreneurship in the sample is set to moderate (average 2.50), while its level is a little higher graded by small firms than medium-sized companies. The results show that a clear destimulant to development of technology entrepreneurship in the group of analyzed entities are actions related to the integration of the business and science sectors. Activity in this

area was estimated to be very low. The average level of synthetic measures for other components of technology entrepreneurship fluctuates in the moderate values, while in the case of each of these, small companies are slightly more involved in various activities than medium-sized companies. Detailed results of the formation of technology entrepreneurship development level of the sample are shown in Table 2.

Table 2 The level of development of technology entrepreneurship in the surveyed companies; Source: Own study based on the results of survey research

Evaluation area	Small companies	Medium-sized companies
The level of development of technology entrepreneurship in total, including:	2.59	2.32
– internal entrepreneurship	3.05	2.61
– internal potential for technology and innovation	2.54	2.33
– integration of business and science spheres	1.87	1.63
– distribution of effects of technology and innovation	2.78	2.58

The surveyed companies at the same time identify specific benefits of the development of technological entrepreneurship. They were divided into 4 groups according to theoretical considerations. The analyzed companies estimate the average level of benefits at a moderate level (average for the sample is 2.80), while slightly higher scores were regularly assigned by respondents from small-sized companies. Detailed results of the level of benefits identified by the respondents are shown in Table 3.

Table 3 Assessment of the benefits from the development of technology entrepreneurship by respondents in the surveyed companies; Source: Own study based on the results of survey research

Group of benefits	Small companies	Medium-sized companies
Level of benefits in total, including:	2.88	2.64
– efficiency benefits	3.02	2.76
– benefits for technology and innovation	2.75	2.71
– organizational benefits	2.84	2.54
– market benefits	3.01	2.71

The results indicate that the major benefits include both positive effects directed at the interior of the organization (e.g. benefits of efficiency of operation), as well as the external effects (primarily market-oriented). The level of the overall benefits of technology entrepreneurship is at the same time positively and significantly associated with the level of development of this concept in the surveyed entities. In the case of small companies, the strength of this relationship takes the strong

value, r_{xy} ($N = 201$) = 0.61, $p < 0.01$, while for medium-sized companies, this relationship shows a very strong correlation: r_{xy} ($N = 99$) = 0.83, $p < 0.01$.

Later in the study, level of barriers to the development of technology entrepreneurship occurring in the analyzed entities was assessed. They were divided into 6 categories identified in the framework of theoretical considerations. The average level of barriers to the development of technology entrepreneurship for the sample is set to moderate-high (average of 3.02), while respondents from small-sized companies generally give higher assessment to barriers than representatives of medium-sized enterprises. Among the factors strongly hindering the development of technology entrepreneurship respondents included market barriers and regulatory and administrative barriers. Detailed results of the assessment of the level of barriers to the development of technology entrepreneurship in the sample are shown in Table 4.

Table 4 Assessment of barriers to the development of technology entrepreneurship in the surveyed companies; Source: Own study based on the results of survey research

Category of barriers	Small companies	Medium-sized companies
Total level of barriers, including:	3.05	2.95
– competence barriers	2.64	2.48
– management barriers	2.74	2.60
– relationship barriers	2.77	2.69
– market barriers	3.75	3.68
– financial barriers	3.12	3.05
– legal/administrative barriers	3.55	3.47

The use of substantive indicators within each synthetic measure helped identify external and internal barriers. The results indicate that the negative exogenous factors (average 3.2) were slightly higher rated by respondents than the endogenous barriers (average 2.8).

Analyzing the impact of the identified barriers on the level of development and the benefits of technology entrepreneurship in the surveyed entities, significance test was used for Pearson's correlation coefficient. On this basis the direction, strength and importance of the relations between the two groups of variables were specified with respect to individual categories of the size of the surveyed enterprises. The results indicate that all the categories of identified barriers have an inhibitory effect (negative), both on the level of development and the benefits of technology entrepreneurship. The level of impact of individual barriers for small firms is more uniform (and takes the weak value, although statistically significant), while among the main factors hindering the development of technology entrepreneurship in medium-sized enterprises respondents included the market barriers and administrative and legal barriers. Detailed results of the relationship

between the identified barriers and the level of development and the benefits of technology entrepreneurship in the surveyed companies are shown in Table 5.

Table 5 Evaluation of the impact of barriers to the development and the benefits of technology entrepreneurship in the sample; Source: own study based on the results of survey research

Category of barriers:	Level of development of technology entrepreneurship		Benefits of development of technology entrepreneurship	
	Small companies	Medium-sized companies	Small companies	Medium-sized companies
Total barriers, including:	-0.27**	-0.34**	-0.23**	-0.45**
– competence barriers	-0.23**	-0.24*	-0.17*	-0.28**
– management barriers	-0.15*	-0.12	-0.13	-0.15
– relationship barriers	-0.13	0.015	-0.09	-0.16
– market barriers	-0.23**	-0.53**	-0.19**	-0.56**
– financial barriers	-0.20**	-0.15	-0.22**	-0.25*
– legal/administrative barriers	-0.22**	-0.57**	-0.19**	-0.58**
– internal barriers	-0.24**	-0.16	-0.21**	-0.23*
– external barriers	-0.26**	-0.44**	-0.22**	-0.56**

* $p < 0.05$; ** $p < 0.01$. Test of significance for the Pearson correlation coefficient r_{xy} (a critical bilateral set)

The results indicate that the lowest-rated was negative impact of the relational barriers and management constraints on the development and level of benefits of technology entrepreneurship in the sample. This is then translated into a greater negative impact of external factors than internal barriers, in particular as regards medium-sized companies.

5. CONCLUSION

Technology entrepreneurship is an interesting proposition for small and medium-sized companies that plan to increase the extent of the market impact through the introduction of technological solutions and innovations based on exploiting the potential of the external environment. This is confirmed by the results of the research, which show a significant and strong relationship between the level of benefits and range of activities related to the development of technology entrepreneurship.

The results also indicate that the concept is underdeveloped and to a very small extent applied in the surveyed companies. The main reason is the very low level of involvement of the analyzed entities in the sphere of relations with the world of

science and research and development activities. At the same time, the development of technology entrepreneurship is limited by a number of barriers, of which fundamental inhibitory role is played by market factors, associated with a strong and unfair market competition and limited market for innovative products and services, as well as legal and administrative factors, including primarily the excessive bureaucratization of processes and administrative procedures and difficulties related to the protection of intellectual property.

The respondents pointed to external factors as the main reasons for limiting the development of technology entrepreneurship. The inhibitory effect of internal barriers has been assessed at a much lower and often statistically insignificant level. These results should be regarded as surprising, particularly in view of the above-identified deficiencies in the sphere of relations between business and science. They can result from insufficient knowledge (and, more broadly – competences) of entrepreneurs in the development of technology entrepreneurship. Therefore, the research should be supplemented with an analysis of selected companies with a high level of development of the described concept in the economic practice. As part of this research, this function was fulfilled by descriptions of three cases of the companies (see, more extensively, Matejun, Szymańska & Walecka, 2013, pp. 171-196), which have largely confirmed the theoretical assumptions.

Poor level of knowledge of the concept and conditions for the development of technology entrepreneurship in the practice of small and medium-sized enterprises also indicates the necessity of activation in support of small business, as well as education and training of people running the companies and would-be entrepreneurs. An important role here will certainly be played by universities, especially in these fields of study which provide specialized training in the area of entrepreneurship and running a small business (see, more extensively, Janczewska, 2014, pp. 27-30). At the same time, further research is required on the factors in the development of technology entrepreneurship in theory and practice of management.

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BIOGRAPHICAL NOTES

Marek Matejun is an assistant professor at the Department of Management, Faculty of Organization and Management at the Lodz University of Technology. His research interests focus on entrepreneurship and managing the development of micro, small and medium-sized enterprises. Other areas of scientific interests are

related to the use of modern concepts and methods of management and research methodology in management sciences. He lectures and holds seminars in the subjects of “Management of small and medium-sized companies” managerial specialty. He is the author or co-author of over 140 scientific publications. His papers appear in numerous international and polish journals including *International Journal of Business and Management Studies*, *International Journal of Economic Sciences, Management*, *Przegląd Organizacji*, *Ekonomika i Organizacja Przedsiębiorstwa*, *Gospodarka Materialowa i Logistyka* and *Research in Logistics & Production*.